

What is claimed is:

1. 1. A method for obtaining a global optimal solution of general nonlinear programming problems, comprising the steps of:
 - 3 a) in a deterministic manner, first finding all local optimal solutions; and
 - 4 b) then finding from said local optimal solutions a global optimal solution.
- 1 2. A method for obtaining a global optimal solution of general nonlinear programming problems, comprising the steps of:
 - 3 a) in a deterministic manner, first finding all stable equilibrium points of a nonlinear dynamical system that satisfies conditions (C1) and (C2); and
 - 4 5 b) then finding from said points a global optimal solution.
- 1 6 3. A practical numerical method for reliably computing a dynamical decomposition point for large-scale systems, comprising the steps of:
 - 3 a) moving along a search path $\varphi_t(x_s) \equiv \{x_s + t \times \hat{s}, \quad t \in \mathbb{R}^+\}$ starting from x_s and detecting an exit point, x_{ex} , at which said search path $\varphi_t(x_s)$ exits a stability boundary of a stable equilibrium point x_d ;
 - 4 6 b) using said exit point x_{ex} as an initial condition and integrating a nonlinear system (4.2) to an equilibrium point x_d ; and
 - 5 7 c) computing said dynamical decomposition point with respect to a local optimal solution x_s wherein said search direction \hat{s} is e x_d .
- 1 8 4. The method of claim 3, wherein a method for computing said exit point comprises the step of:
 - 3 moving along said search path $\varphi_t(x_s) \equiv \{x_s + t \times \hat{s}, \quad t \in \mathbb{R}^+\}$ starting from x_s and detecting said exit point x_{ex} , which is a first local maximum of an objective function $C(x)$ along said search path $\varphi_t(x_s)$.
- 1 9 5. The method of claim 3, wherein a method for computing a minimum distance point (MDP) comprises the steps of:

3 a) using said exit point x_{ex} as an initial condition and integrating a nonlinear
 4 system (4.2) to a first local minimum of a norm $\|F(x)\|$, where
 5 $F(x)$ is a vector of a vector field (4.2), and a local minimum point
 6 is x_d^0 ;

7 b) using said MDP $x_{d,j}^{l,0}$ as an initial guess and solving a set of nonlinear
 8 algebraic equations of said vector field (4.2) $F(x) = 0$, wherein a
 9 solution is x_d , and a dynamical decomposition point with respect to
 10 the local optimal solution x_s and said search path $\varphi_t(x_s)$ is x_d .

1 6. The method of claim 3, wherein a method for computing said exit point comprises the
 2 step of computing an inner-product of said search vector and vector field at each
 3 time step, by moving along said search path $\varphi_t(x_s) \equiv \{x_s + t \times \hat{s}, \quad t \in \mathbb{R}^+\}$ starting
 4 from x_s and at each time-step, computing an inner-product of said search vector \hat{s}
 5 and vector field $F(x)$, such that when a sign of said inner-product changes from
 6 positive to negative, said exit point is detected.

1 7. The method of claim 3, wherein a method for computing said exit point comprises the
 2 step of:

3 a) moving along said search vector until an inner-product changes sign
 4 between an interval $[t_1, t_2]$;

5 b) applying a linear interpolation to an interval $[t_1, t_2]$, which produces an
 6 intermediate time t_0 where an interpolated inner-product is expected
 7 to be zero;

8 c) computing an exact inner-product at t_0 , such that if said value is smaller
 9 than a threshold value, said exit point is obtained; and

10 d) if said inner-product is positive, then replacing t_1 with t_0 , and otherwise
 11 replacing t_2 with t_0 and going to step b).

1 8. The method of claim 3, wherein a method for computing a minimum distance point
 2 (MDP) comprises the steps of:

3 a) using said exit point as an initial condition and integrating a nonlinear
 4 system for a few time-steps;

5 b) checking convergence criterion, and, if a norm of said exit point obtained
 6 in step a) is smaller than a threshold value, then said point is
 7 declared as said MDP, and otherwise, going to step b);

8 c) drawing a ray connecting a current point on a trajectory and a local
 9 optimal solution, replacing said current point with a corrected exit
 10 point, which is a first local maximal point of objective function
 11 along said ray, starting from a stable equilibrium point, and
 12 assigning this point to said exit point and going to step a).

1 9. The method of claim 3, wherein a method for computing said dynamical decomposition
 2 point with respect to a stable equilibrium point x_s and a search vector \hat{s} ,
 3 comprises the steps of:

4 a) moving along said search path $\phi_t(x_s) = \{x_s + t \times \hat{s}, t \in \mathbb{R}^+\}$ starting from
 5 x_s and detecting a moment that an inner-product of said search
 6 vector \hat{s} and vector field $F(x)$ changes sign, between an interval
 7 $[t_1, t_2]$, stopping this step if t_1 is greater than a threshold value and
 8 reporting that there is no adjacent local optimal solution along this
 9 search path, and otherwise, going to step b);

10 b) applying linear interpolation to said interval $[t_1, t_2]$, which produces an
 11 intermediate time t_0 where said interpolated inner-product is
 12 expected to be zero, computing an exact inner-product at t_0 , and if
 13 said value is smaller than a threshold value, said exit point is
 14 obtained, and going to step d);

15 c) if said inner-product is positive, then replacing t_1 with t_0 , and otherwise
 16 replacing t_2 with t_0 and going to step b);

17 d) using said exit point as an initial condition and integrating a nonlinear
 18 system for a few time-steps;

19 e) checking convergence criterion, and if a norm of said point obtained in
 20 step d) is smaller than a threshold value, then said point is declared
 21 as the MDP and going to step g), and otherwise going to step e);

22 f) drawing a ray connecting a current point on said trajectory and a local
 23 optimal solution, replacing said current point with a corrected exit

24 point which is a first local maximal point of objective function
 25 along said ray starting from a stable equilibrium point, and
 26 assigning this point to said exit point and going to Step d); and

27 g) using said MDP as an initial guess and solving a set of nonlinear
 28 algebraic equations of the vector field (4.2) $F(x) = 0$, wherein a
 29 solution is t_d , such that said DDP with respect to a local optimal
 30 solution x_s and vector \hat{s} is x_d .

1 10. The method of claim 3, wherein at least one effective local search method is combined
 2 with said dynamical trajectory method of claim 3, comprising the steps of:

- 3 a) given an initial point, integrating a nonlinear dynamical system described
 4 by (4.2) that satisfies condition (C1) from an initial point for a few
 5 time-steps to get an end point and then updating said initial point
 6 using an endpoint, before going to step b);
 7 b) applying an effective local optimizer starting from said end point in step
 8 a) to continue the search process. , and if it converges, then
 9 stopping, or otherwise, returning to step a).

1 11. The method of claim 3, wherein said method is used to accomplish a result selected
 2 from the group consisting of:

- 3 a) escaping from a local optimal solution;
 4 b) guaranteeing the existence of another local optimal solution;
 5 c) avoiding re-visit of a local optimal solution of step b);
 6 d) assisting in searching a local optimal solution of step b); and
 7 e) guaranteeing non-existence of another adjacent local optimal solution
 8 along a search path.

1 12. The method of claim 3, wherein a numerical method for performing a procedure,
 2 which searches from a local optimal solution to find another local optimal solution
 3 in a deterministic manner, comprises the steps of:

- 4 a) moving along a search path starting from x_{opt} and applying said DDP
 5 search method to compute a corresponding DDP, and going to step

- 6 b), and if a DDP can not be found, then trying another search path
7 and repeating this step;
- 8 b) letting said DDP be denoted as x_d , and if x_d has previously been found,
9 then going to step a), otherwise going to step c);
10 c) computing a DDP-based initial point $x_0 = x_{opt} + (1 + \varepsilon)(x_d - x_{opt})$ where
11 ε is a small number, and applying a hybrid search method starting
12 from x_0 to find a corresponding adjacent local optimal solution.